

Solid Waste: Landfills and Incineration

PBDE Emissions from Solid Waste in WA

- Unknown quantity of PBDEs
 - currently in WA landfills or
 - disposed to landfills or incineration on annual basis
- No WA data on emissions from landfills or incinerators to air, land, or water

Waste categories that may contain PBDEs

WA waste composition analysis, 2003

Waste category	Percent of total municipal solid waste
Plastics/other materials	2.5%
Electronics	0.3%
Furniture/mattresses	1.4%
Carpet and carpet pad	2.3%
Total percent of waste that may contain PBDEs	6.5%

6.5% equivalent to 360,000 tons of waste that may contain PBDEs.

WA Solid Waste Facilities

- 16 active MSW landfills
- 13 active Limited Purpose landfills
 - 11 unlined (leachate monitored at 1)
 - 2 lined
- 1 incinerator
 - Incinerator ash disposed in monofill with no leachate
 - Controls in place for dioxin

Leachate volume at four of larger MSW landfills serving WA, 2004

Facility	County	Total leachate sent to WWTP, gal	Other pertinent info
LRI (2004)	Pierce	1,741,131	2,237,500 gal recirculated.
Roosevelt	Klickitat	0	All leachate recirculated and evaporated.
Cedar Hills	King	181,610,000	Big facility with 200 acres producing leachate.
Columbia Ridge	(OR)	0	Lined; leachate collected, recirculated

Pathways: Landfills

- **Air**- No literature identified measuring PBDEs from the open face of a landfill
- **Groundwater**- One study found no correlation between landfills within one km and elevated concentrations of PBDEs in the Columbia River, BC (Rayne, et al.)
- **Leachate**- 3 studies identified that examined PBDEs in landfill leachate
 - Coagulation/sedimentation process efficiently removed PBDEs from leachate; care should be taken with resulting sludge (Osaka, et al.)
 - Lower pH increased uptake of PBDEs (Danon-Schafer)

PBDEs in MSW leachate (ng/L)

Congener totals	1980- 1984	1985 - 1989	1990 - 1994	1995 - 1999	2000 - 2005
MonoBDEs	0.157	0.119	0.134	0.243	0.317
DiBDEs	0.0272	0.045	0.0275	0.352	0.639
TriBDEs	0.0779	0.037	0.0879	0.977	6.490
TetraBDEs	0.332	0.522	0.393	15.300	355.000
PentaBDEs	0.394	0.644	0.343	35.700	743.000
HexaBDEs	0	0.855	0.390	13.800	257.000
HeptaBDEs	1.220	2.190	0.907	4.650	20.400
OctaBDEs	0.548	3.450	1.450	4.050	17.800
NonaBDEs	0	2.280	0.966	2.550	11.500
DecaBDEs	0	5.300	2.710	10.000	56.700
Total BDEs	2.756	15.442	7.408	87.622	1,468.846

PBDE Concentrations in Landfill Leachates (ng/L), MN

Type of Leachate	47	99	100	154	207	208	209	Total PBDEs
Demolition	.64	.95	.17	.11	.83	.57	243.84	248.07
Municipal	5.02	7.52	1.55	.87	1.51	.80	34.54	56.50
Municipal	2.59	4.24	.98	.68	.28	.17	28.54	45.97
Industrial	.18	.23	.05	.02	.14	.08	35.04	35.91
Municipal	.62	.85	.17	.09	.79	.45	24.74	28.82

Pathways: Incineration

- Atmospheric concentrations outside an MSW incinerator with electronics recycling were higher than an industrial control site (Agrell et al.)
- Several studies have shown possible that PBDD/Fs formed
 - Dioxin controls installed for chlorinated dioxins should also control brominated dioxins
 - No stack measurements identified

Potential Risks

- Leachate potentially containing PBDEs is processed at a wastewater treatment plant- PBDEs may end up in sludge or effluent
- Potential direct release to environment via air and groundwater (if unlined)

Key Uncertainties

- Concentration of PBDEs in leachate-variability over time and between landfills
- Removal efficiency of leachate treatment processes
- Concentration of PBDEs in sludge and effluent from treated leachate
- PBDE emissions to air from landfills
- Impact of auto fluff on emissions to air and leachate

Potential Management Options

- If PBDEs are released to the air from the open face:
 - Require that all PBDE-containing waste go to an incinerator.
 - Require that the open face be minimized.
 - Require that all PBDE-containing waste be pre-treated with an inert stabilizer to minimize dust exposure.
 - No action.

Potential Management Options

- If PBDEs are released in leachate:
 - Require that all PBDE-containing waste go to an incinerator or to a landfill that does not release leachate.
 - Require that leachate be pretreated through a settling/coagulation process (or some other process shown to remove PBDEs) and have the sludge disposed in a landfill that does not release leachate.
 - Send all leachate to a dangerous waste landfill.
 - Require PBDE monitoring in sludge and discharge water, through NPDES permit.
 - No action.